

# **Listening Environments: School & Home**

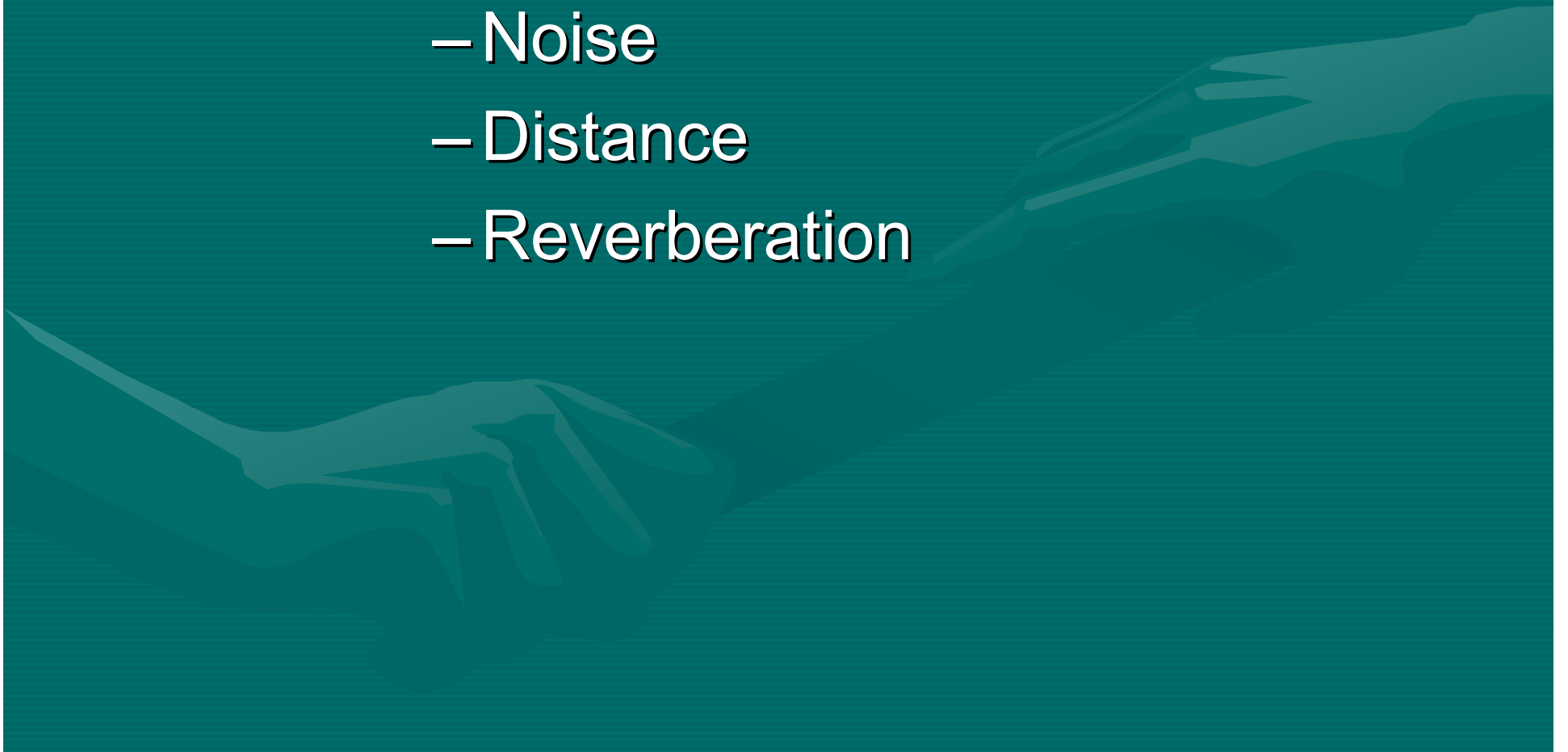
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**WESP-DHH Outreach**

# What Affects Listening?

- Environmental Factors
  - Noise
  - Distance
  - Reverberation



# What Affects Listening?

- Personal Characteristics

- Hearing ability
- Attention
- Knowledge of topic
- Language complexity
- Motivation
- Comfort

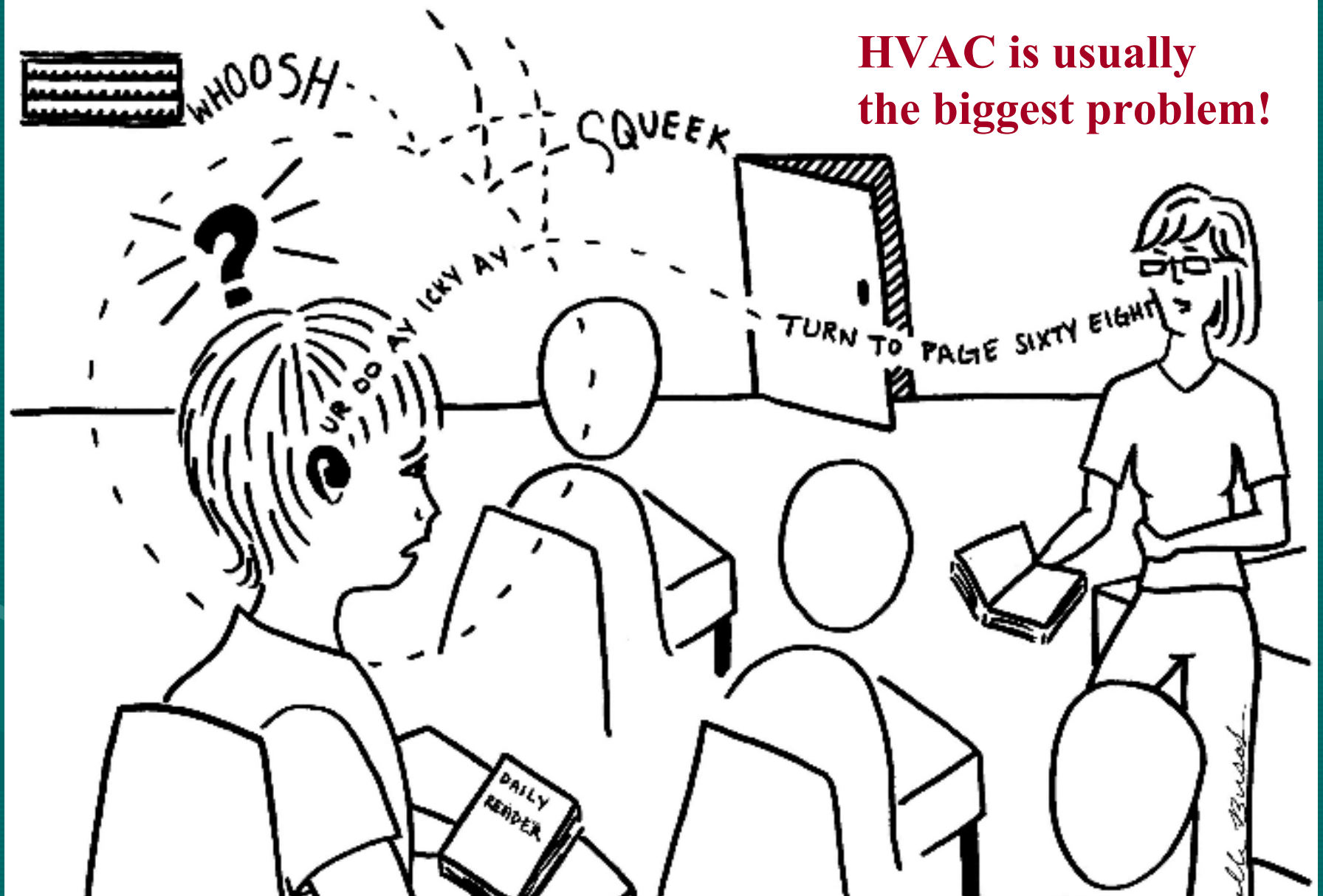
These factors all vary between children  
and throughout every day

# Classrooms are based on Listening

- Listening is the cornerstone of the educational system
- If a child cannot clearly hear and attend to spoken instruction, all of their learning can be affected
- Classrooms can be noisy, reverberant learning environments
- Children with hearing loss have a right to **equal access to verbal instruction in all environments**

## The “fragile” speech signal – What can a child really hear??

- “Hearing speech” is not the same as hearing all of the sounds in all of the words
- Speech sounds can vary by 30 dB (‘th’ in thaw vs ‘oo’ in through)
- Vowels are the loudest and least affected by hearing loss
- Consonants are the softest and are most important to speech discrimination
- Noise tends to mask the most critical elements of speech
- Reverberation smears the speech signal by adding more distortion



**HVAC is usually  
the biggest problem!**

# Signal-to-Noise Ratio

- How loud the teacher or speaker's voice is compared to the background noise
  - + 20dB S/N = Teacher's voice is 20 dB above the noise
  - + 5dB S/N = Typical classroom
  - 0 dB S/N = Teacher's voice same level as noise
  - 5dB S/N = Teacher's voice softer than noise

# Picking speech out of background noise - analogy

I see some beautiful flowers.	+20
Big dogs can be dangerous.	+15
I like to go to school.	+10
It is lunch time soon.	+5
Walk to the library now.	0
Your brother is not here.	-5



# Distance – the myth of preferential seating

- The closer a sound source is to the ear the louder it will be heard and the less background noise will interfere
- How close is close enough to the teacher?
  - To know she is talking?
  - To really understand what she is saying?
  - How far is the first seat in the row?
  - How far is the last seat?

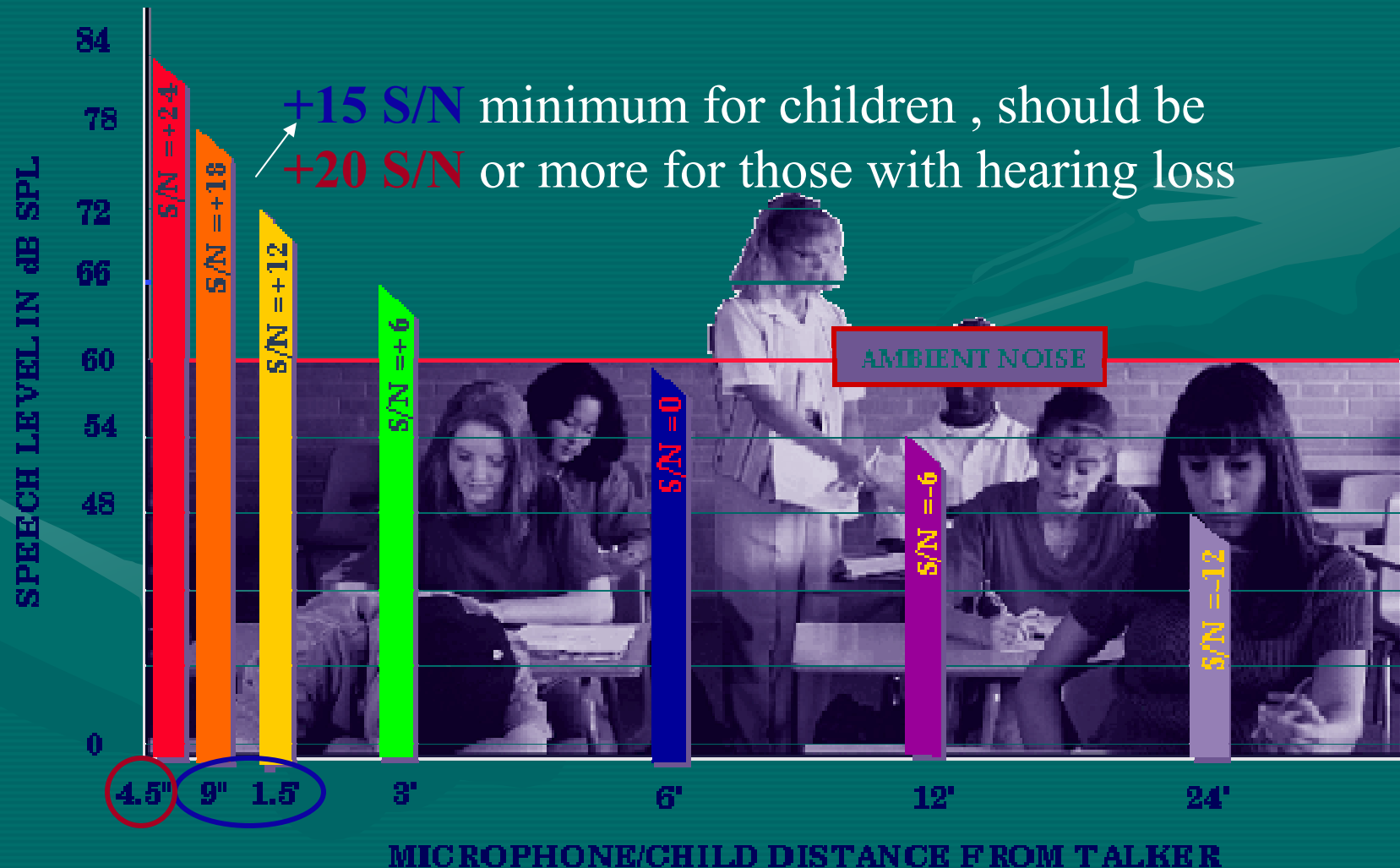
# Distance – the myth of preferential seating

- Optimal listening occurs within 6 feet
- Which seat is best, things to consider:
  - Visual / auditory access to teacher & peers
  - Right, left or center
  - Physical characteristics of the room – lights, doors, noise sources
  - Physical characteristics of the building – playground, mechanical systems, music / gym

# Listening at Home

- Meal times
- Homework
  - Location
  - Set-up
  - Noise sources
- Directions / Requests
  - Distances
  - Noise sources

# Effect of Distance on Speech Loudness over Noise (S/N)



# Reverberation...

- Sound reflected off of hard surfaces like walls, ceilings, floors, etc. (echo)
- Interferes with sound by smearing the signal, making it less clear and harder to understand, especially speech
- Most noticeable in large rooms like gymnasiums, auditoriums & cafeterias
- Present in all rooms to some extent

# Reverberation...

- Less noticeable in smaller rooms
- Rooms with softer surfaces like carpet, window coverings, furniture
- Lower ceilings, acoustic tiles

# Speech sounds smear as Reverberation Time increases

**I see some beautiful flowers.**

**Big dogs can be dangerous.**

**I like to go to school.**

**It is lunch time soon.**

**Your brother is not there.**

**Walk to the library now.**

**I want peanut butter sandwich.**

Small, carpeted  
room,  
livingroom

Increasing Reverberation Time

Large, hard  
surface room,  
gym / cafeteria

# How do you know what's missing?

- Relationship Of Hearing Loss To Listening And Learning

- [www.kandersonaudconsulting.com](http://www.kandersonaudconsulting.com)

- Individual summaries for nine different levels / types of hearing loss

- 16-25 dB Loss
    - 26-40 dB Loss
    - 41-55 dB Loss
    - 56-70 dB Loss
    - 71-90 dB / 91+ dB Loss
      - Unilateral
    - Mid-frequency / Reverse Slope
      - High Frequency
      - Fluctuating



## Relationship of Hearing Loss to Listening and Learning Needs

Child's Name:

Date:

### HIGH FREQUENCY HEARING LOSS

Possible Impact on the Understanding of Language and Speech	Possible Social Impact	Potential Educational Accommodations and Services
<ul style="list-style-type: none"> <li>Child can "hear" but can miss important fragments of speech.</li> <li>Even a 26 - 40 dB loss in high frequency hearing may cause the child to miss 20%-30% of vital speech information if unamplified.</li> <li>Consonant sounds t, s, f, th, k, sh, ch likely heard inconsistently, especially in the presence of noise.</li> <li>May have difficulty understanding faint or distant speech, such as a student with a quiet voice speaking from across the classroom and will have much greater difficulty understanding speech when in low background noise and/or reverberation is present.</li> <li>Many of the critical sounds for understanding speech are high pitched, quiet sounds, making them difficult to perceive; the words: cat, cup, call, car could be perceived as "ca," word endings, possessives, plurals and unstressed brief words are difficult to perceive and understand.</li> <li>Speech production may be affected.</li> <li>Use of amplification often indicated to learn language at a typical rate and ease learning.</li> </ul>	<ul style="list-style-type: none"> <li>May be accused of selective hearing due to discrepancies in speech understanding in quiet versus noise.</li> <li>Social problems may arise as child experiences difficulty understanding in noisy cooperative learning situations, lunch or recess.</li> <li>May misinterpret peer conversations.</li> <li>Child may be fatigued in classroom due to greater listening effort.</li> <li>May appear inattentive, distractible or frustrated.</li> <li>Could affect self concept.</li> </ul>	<ul style="list-style-type: none"> <li>Student is at risk for educational difficulties.</li> <li>Depending upon onset, degree and configuration of loss, child may experience delayed language and syntax development and articulation problems.</li> <li>Possible difficulty learning some sound/letter associations in kindergarten and 1st grade classes.</li> <li>Early evaluation of speech and language skills is suggested.</li> <li>Educational monitoring and teacher inservice is warranted.</li> <li>Will typically benefit from personal hearing aids and use of a sound-field or a personal FM system in the classroom.</li> <li>Use of ear protection in noisy situations is imperative to prevent damage to inner ear structures and resulting progression of the hearing loss.</li> </ul>

Comments:

### Please Consider Indicated Items in the Child's Educational Program:

- |   |  |  |
|---|--|--|
| <input type="checkbox"/> Teacher inservice and seating close to teacher   | <input type="checkbox"/> Hearing monitoring at school every ____ mo.                         | <input type="checkbox"/> Amplification monitoring                |
| <input type="checkbox"/> Contact your school district audiologist   | <input type="checkbox"/> Protect ears from noise to prevent more loss                        | <input type="checkbox"/> Educational support services/evaluation |
| <input type="checkbox"/> Screening/evaluation of speech and language  | <input type="checkbox"/> Note-taking, closed captioned films, videos                         | <input type="checkbox"/> FM system trial period                  |
| <input type="checkbox"/> Educational consultation/program supervision by specialist(s) in hearing loss                        | <input type="checkbox"/> Regular contact with other children who are deaf or hard of hearing |  |
| <input type="checkbox"/> Periodic educational monitoring such as October and April teacher-student completion of SIFTER, LIFE |  |  |

NOTE: All children require full access to teacher instruction and educationally relevant peer communication to receive an appropriate education. Distance, noise in classroom and fragmentation caused by hearing loss prevent full access to spoken instruction. Appropriate acoustics, use of visuals, FM amplification, sign language, notetakers, communication partners, etc. increase access to instruction. Make periodic hearing evaluation, rigorous amplification checks, and regular monitoring of access to instruction and classroom function (monitoring tools at [www.hear2learn.com](http://www.hear2learn.com) or [www.SIFTERkids.com](http://www.SIFTERkids.com)).

# “Missing speech”

- At 30 dB a child can miss 25% - 40% of the speech signal
- At 35 – 40 dB there may be 50% or more missed
- Example :

***Please get out your math book and turn to page two sixty-seven.***

- Example of perceiving the same direction in quiet with high frequency hearing loss:

***eaz ge ou your ma book an urn oo page oo ixie evn***

- Example of perceiving this direction with some high frequency hearing loss while listening in noise:

***ee e ou or a ook an ur oo a oo iee e***

# Increased difficulty tuning into the small differences between words

- with a hearing loss AND

when any child is listening in noisy classroom conditions



"So, Andrel . . . The king wants to know how you're coming with St. George and the Dragon."

# Equal access to verbal instruction: What can we do?

- Reduce distance
- Minimize background noise
- Reduce Reverberation
- Monitor function of child's amplification
- Use Assistive Listening Devices / FM Systems provide the speech signal within the critical listening distance
- Monitor child's function in the classroom and at home



# Control the noise...

- Can it be turned down / off?
  - School – fans, computers, background music
  - Home – TV, music, dishwasher, washer / dryer
- Compare rooms, is one better than another?
  - School – location, external noise sources
  - Home – kitchen, dining room, living room
- Will repairs or replacement help?
  - Heating / cooling systems
- Keep doors closed

# Reduce the reverberation....

- Increase sound absorbing materials
  - use curtains, furniture, bookshelves, mobiles, tapestry hangings, etc.
  - good acoustic tile on ceiling (0.65 absorption coefficient or better)
  - acoustic panels (1" minimum) on walls and/or carpet on the floor
  - angle the bottom of black or white boards so that sound will be more effectively reflected to ceiling

# What type of assistive listening device / FM System is best?



Oticon Amigo

Classroom  
Sound Field?  
Desktop FM?  
Personal FM?



Lifeline Patriot



Advanced Bionics  
Harmony with iConnect  
to Phonak MLxi



Phonak MLx



Lightspeed RedCat Infrared

# Assistive Listening Devices / FM Systems

- Improves the Signal to Noise ratio
  - From:
    - Signal to NOISE
  - To:
    - SIGNAL to Noise
  - 5-20 dB Improved S/N Ratio



# What does it sound like?

- Quiet
- Noise
- ALD/FM System
- Linda Thibodeau

[http://www.utdallas.edu/~thib/fm\\_wav.html](http://www.utdallas.edu/~thib/fm_wav.html)

# What's the Difference?

- All have a transmitter / microphone
- FM vs. Infrared
- Sound Field – speaker/s located throughout the room
- Desktop / Portable – single speaker located near student
- Personal – connected to student – can be through earphones, hearing aids, CIs
- Combination of Systems

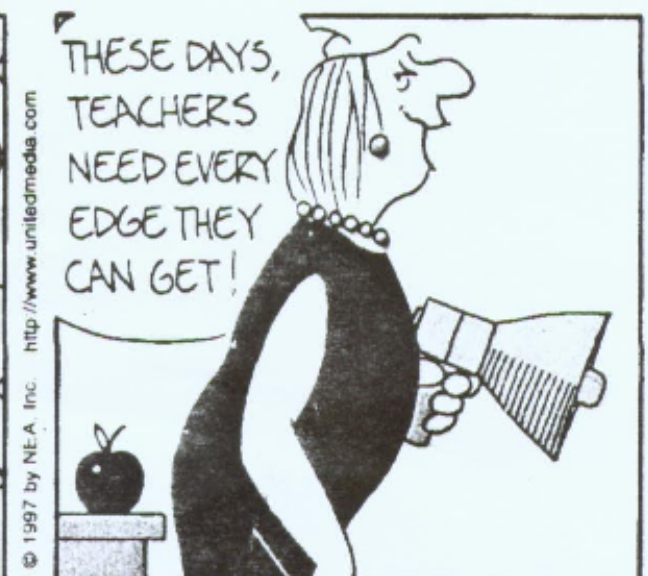
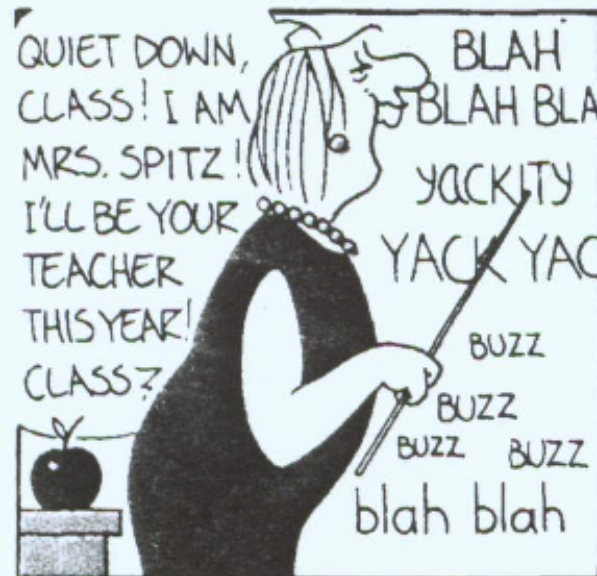
# What's the Difference?

- Sound Field FM / Infrared  
+5 dB S/N
- Desktop systems  
+5-10 dB S/N
- Personal FM systems  
+15-20 dB S/N

# Using ALDs or FM Systems...

- Will NOT address the need to reduce noise and reverberation levels
- Helps reduce the effects of distance and noise to help the child receive the best speech signal possible
- May have limited benefit for hearing their peers better

**THE BORN LOSER** by Art and Chip Sansom



Thank you for  
**LISTENING**

Questions??

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